Space Weather Technical Forecast

Issued on Thursday, 15 February 2024 at 13:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance G1 Minor Storms Day 1 (15 Feb) due to possible CME arrival. Isolated M-flares likely, and slight chance X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been LOW in the last 24 hours with only C-class flares observed, the max observed being a C7.5 flare at 14/1756 UTC. Moderate activity is likely with isolated M-flares and a slight chance of X-class flares. The greatest risk is from AR3576.

There are currently seven numbered and two un-numbered sunspot regions on the visible disc. AR3576 persists as the largest and most complex region with two delta configurations, however some weakening of the peripheral trailing spots is evident on most recent imagery but this will likely become more difficult to analyse as it as it transits toward the western limb. AR3582 and AR3583 are the next largest regions. Slight decay has been observed in both. AR3586 continues to turn onto the far northeast of the disc, and despite foreshortening appears to clearly be a moderate size Hsx/Alpha. Remaining spot regions are small and magnetically simple. No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as recorded by DSCOVR/ACE were at slightly elevated levels for most of the period (400-450km/s), but fell to background levels (350-400km/s) from 15/0700 UTC. Density was at or near below average levels. Interplanetary magnetic field (IMF) Bt, was at weak levels, 4-7nT, but became moderate around 9nT at 14/2218 UTC until 15/0100 UTC. The north-south directed field, Bz, varying weakly between -4 and 7nT. Phi angle was negative (toward from the Sun) from around 14/1730 UTC until 15/0600 UTC, otherwise was positive (Away from the sun). Geomagnetic activity was Quiet (Kp 0 to 1).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was above the S1 Minor Radiation Storm at the start of the period, starting at 30 pfu and gradually declining below the S1 level after 14/2000 where it has since remained. GOES16 high energy (greater than 2MeV) electron flux remained at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observed fluence at 15/0000UTC was 1.32e6 pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with the likelihood of further isolated M-flares, and a slight chance of X-flares. These most likely from AR3576 in the southwest.

Solar Wind / Geomagnetic Activity: There are no earth directed CMEs in the forecast.

Solar winds are currently at background levels and no significant coronal hole enhancements are expected, with coronal hole 97 likely too far south, and small coronal hole 99 likely too far north to influence solar winds at Earth. Two new coronal holes have developed near central limb but these are expected to be too small to have any major impact.

Quiet activity is expected, with a chance of isolated Unsettled intervals.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux

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is now below the S1 Minor Radiation Storm and on a slowly declining trend. Proton flux is expected to continue slowly declining through the period in the absence of further significant flare activity. However, there does remain an ongoing chance of further enhancements, most likely from AR3576, given any significant flares.

High energy electron flux (greater than 2MeV) is expected to remain at background. The associated 24-hour electron fluence is expected to stay below the active threshold, but perhaps with a rising trend later in the period.

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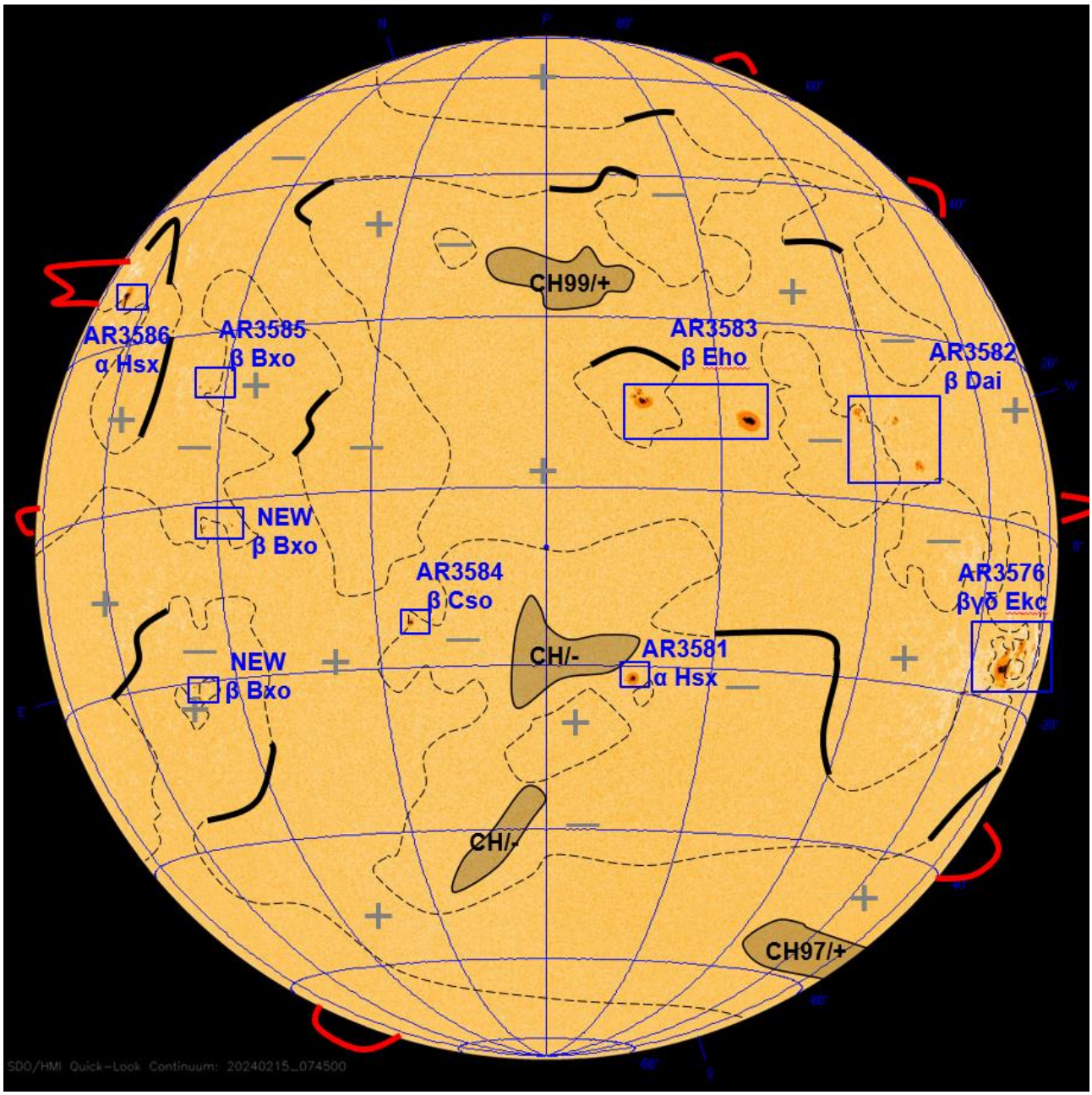
Figure 1. Solar Analysis Valid 15/0745 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no earth directed CMEs in the forecast.

Solar winds are currently at background levels with no further enhancements from any CMEs expected. There are also no significant coronal hole enhancements expected, with coronal hole 97 likely too far south, and small coronal hole 99 likely too far north to influence solar winds at Earth. Two coronal holes have appeared in the central limb and are yet unnamed, both however are small and are also not expected to have any significant influence on coronal wind speed.

A slight chance of Active to G1 Minor Storms is maintained for day 1 (15 Feb) given some likely weak CME influence at first. Otherwise, Quiet activity is expected, with a chance of isolated Unsettled intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected with the ongoing likelihood of isolated M-flares, and a slight chance of X-class flares. These most likely from AR3576 in the near term with the persistence of a delta spot configuration within the region maintaining the complexity and consequently the potential for significant flares. This region rotates over the west limb by day 3, however the flare risk from this region will likely continue until the end of the period.

AR3582 and AR3583 in the northwest quadrant are also moderately sized bi-polar regions, however these have a simpler magnetic configuration, and a horizontally aligned field, giving a lower potential for notable flares. Both these regions remain relatively stable with some slight decay now evident.

Also of interest is a new region AR3586 moving onto the northeast disc. This region may have been the source of a M2.6 flare from over the limb on 12 Feb, and could reveal further complexity in the days.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	70	70	60	50
Very Active	R3 to R5 X Class	No	15	15	10	10

Figure 2: GOES 16 & 18 X-ray flux for past 24 hrs:

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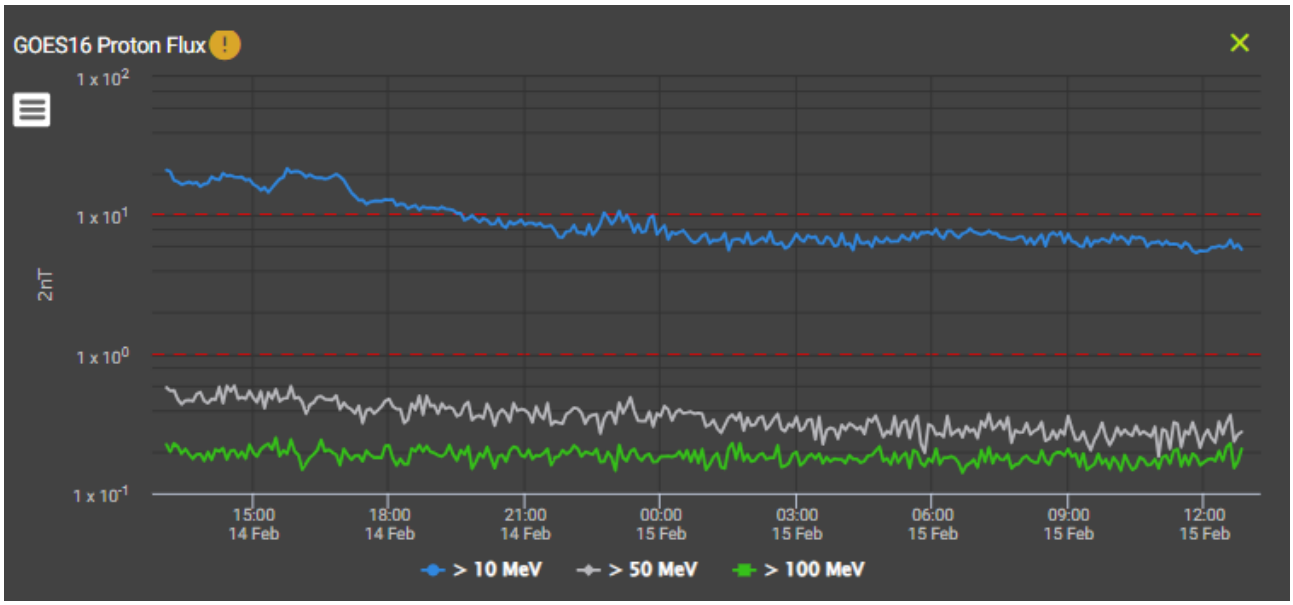
Solar Radiation Storms - (High Energy Protons):

GOES 18 high energy (greater than 10MeV) protons was enhanced above the S1 threshold at the start of the period starting at 30 pfu and gradually declining below the S1 level after 14/2000 following a large far-sided flare on 13 Feb, most likely originating from ex-AR3575 rotating towards the centre of the far-side disc.

Proton flux is expected to continue slowly declining through the period in the absence of further significant flare activity. However, there does remain an ongoing chance of further enhancements, most likely from AR3576, given any significant flares, This is due its location in the western disc, which is favourable for any protons to be directed towards Earth. Later in the period this risk should diminish as it rotates beyond the west limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	30	25	20	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: GOES-18 Proton flux.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is forecast to persist at background.

The associated 24 hour electron flux is expected to remain well below the Active (1e8 integrated pfu) threshold, but may see an increasing trend later in the period. REFM is thought to be giving generally good guidance in the absence of any significant further CME arrivals.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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